American Association *of* Jesuit Scientists

EASTERN STATES DIVISION

PROCEEDINGS

of the

EIGHTH ANNUAL MEETING

HOLY CROSS COLLEGE
WORCESTER, MASSACHUSETTS

AUGUST 11, 12, 13, 1929

VOL. VII

NO. 1

American Association *of* Jesuit Scientists

EASTERN STATES DIVISION

PROCEEDINGS

of the

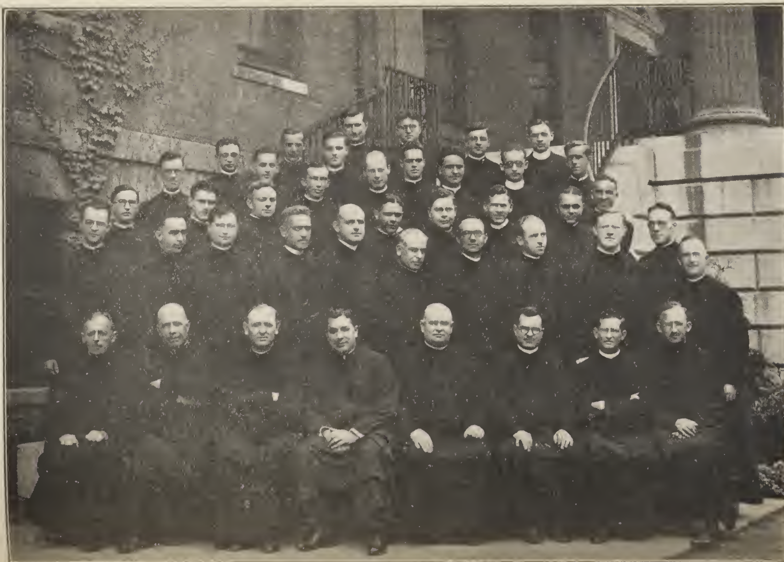
EIGHTH ANNUAL MEETING

HOLY CROSS COLLEGE
WORCESTER, MASSACHUSETTS

AUGUST 11, 12, 13, 1929

VOL. VII

NO. 1



[illegible] CONVENTION, [illegible]

BULLETIN OF AMERICAN ASSOCIATION OF JESUIT SCIENTISTS

EASTERN STATES DIVISION

VOLUME VII NO. 1

PROGRAM OF GENERAL MEETINGS

SUNDAY, AUGUST 11, 7.45 P. M. — *Chemistry Amphitheatre O'Kane Building*

Address of Welcome - - - - - - - - Rev. John M. Fox, S.J.

Reading of Minutes. Appointment of Committees.

Presidential Address - - - - - - Rev. Richard B. Schmitt, S.J.
"THE RELATION OF 'THE SCIENCES' TO PHILOSOPHY."

New Business Adjournment

TUESDAY, AUGUST 13, 1.00 P. M. — *Chemistry Amphitheatre O'Kane Building*

Reports of the Secretaries. Reports of Committees.

Discussion. Resolutions.

Election of Officers. Adjournment.

PROGRAM OF SECTIONAL MEETINGS

Biology Section

MONDAY, AUGUST 12, 9.00 A. M.—3.00 P. M.

Biology Lecture Room
Beaven Hall.

TUESDAY, AUGUST 13, 9.00 A. M.

Chairman's Address - - - - - - - -	Rev. John A. Frisch, S.J
THE LIFE HISTORY OF AMMOBIA ICHNEUMONIA, L.	
Demonstration of the Skeleton in Vertebrates - - - - - - - - - - -	REV. J. S. DIDUSH, S.J.
Reasons for Biology in the A. B. Course - - - - - - - - - - -	REV. D. V. McCAULEY, S.J
Laboratory Furniture - - - - - -	REV. C. E. SHAFFREY, S.J
College Museums - - - - - - -	REV. F. X. REARDON, S.J
Pools, Ponds and Their Construction -	REV. J. A. FRISCH, S.J.
Further Hereditary Considerations -	CHARLES A. BERGER, S.J.
The Habitat of Fungi and Mosses -	HAROLD L. FREATMAN, S.J.
The Effect of U-V Rays on Living Tissue - - - - - - - - - - -	JAMES L. HARLEY, S.J.

Chemistry Section

MONDAY, AUGUST 12, 9.00 A.M.—3.00 P. M.

Chemistry Lecture Room.
O'Kane Building.

TUESDAY, AUGUST 13, 9.00 A. M.

Chairman's Address - - - - - -	Rev. Richard B. Schmitt, S.J.
DECOMPOSITION OF SUCROSE.	
Determination of Beeswax in Candles	EDWARD S. HAUBER, S.J.
Analysis of Wine and Flour - - - -	REV. F. W. POWER, S.J.
Analysis of Coal and Fuel Oil - - -	REV. A. J. HOHMAN, S.J.
Analysis of Blood - - - - - - - -	REV. M. J. AHERN, S.J.
Analysis of Urine - - - - - - - -	REV. A. J. LANGGUTH, S.J.
Anaysis of Water - - - - - - - -	ANTHONY S. CARROLL, S.J.
The Effect of U-V Radiation on Glucosazone - - - - - - - - - - -	REV. G. F. STROHAVER, S.J.
Quantitative Reactions in Acid and Basic Analysis - - - - - - -	REV. G. L. COYLE, S.J.
Determination of Halogens in Organic Compounds - - - - - - - -	LAWRENCE C. GORMAN, S.J.
Experiments in Fire-polished Glass -	REV. J. J. SULLIVAN, S.J.

Report on Chemical Research in Our Colleges by
the Respective Heads of Departments

PROGRAM OF SECTIONAL MEETINGS

Physics Section

MONDAY, AUGUST 12, 9.00 A. M.—3.00 P. M.

Physics Lecture Room.
Alumni Hall.

TUESDAY, AUGUST 13, 9.00 A. M.

Chairman's Address - - - - - - Rev. William G. Logue, S.J.
UNITY CHARTS IN TEACHING.

Recent Studies in Cosmic Rays - - -	REV. H. M. BROCK, S.J.
The Development of the Compass - -	REV. T. J. LOVE, S.J.
Prominence Spectroscope - - - -	GEORGE P. McGOWAN, S.J.
Are Molecules Actualities - - - -	REV. J. P. MERRICK, S.J.
Lenses - - - - - - - - - - - -	EDMUND J. NUTTALL, S.J.
The Signification of "Energy" in the New Physics - - - - - - - -	JAMES D. LOEFFLER, S.J.

MONDAY, AUGUST 12, 7.30 P. M. *Auditorium.*

New Developments in Motion Pictures: Sound and Color.
Rev. M. J. Ahern, S.J. (Illustrations and Demonstration)

Exhibition and demonstration of latest scientific apparatus by:
Bausch and Lomb Optical Co., Rochester, N. Y.
Central Scientific Co., Chicago, Ill.

In Laboratories O'Kane Building

Mathematics Section

Meetings in conjunction with the Physics Section

A Simple-average Computer - - -	REV. C. A. ROTH, S.J.
Teaching the Slide Rule - - - - -	THOMAS H. QUIGLEY, S.J.
Mathematics in the High Schools - -	WILLIAM H. CUSICK, S.J.

PROCEEDINGS

FIRST GENERAL SESSION

The eighth annual meeting of the American Association of Jesuit Scientists, Eastern States Division, was held at Holy Cross College, Worcester, Mass., on August 11-13th, 1929. The general meeting was called to order by Rev. Richard B. Schmitt, at 7.45 P.M. in the Chemistry Ampitheater.

A cordial welcome was extended to all the members by Rev. Fr. Crawford, who spoke in place of Rev. Fr. Fox, Rector of Holy Cross. The minutes of the previous meeting were accepted as read. The treasurer's report was also accepted without comment. The chairman read a letter from Very Rev. Fr. Provincial expressing regret at his inability to attend, but wishing all success and God's blessing on the meetings. Fr. Morgan, president of the Jesuit Scientists' Association, Mid-Western Division, was an interested visitor during the three days of the convention.

The chairman named the following committees:

Committee on Nominations:—
- Fr. Brock, *Chairman*
- Fr. Didusch
- Fr. Shaffrey

Committee on Resolutions:—
- Fr. Ahern, *Chairman*
- Fr. Hohman
- Fr. Logue

Then followed the

PRESIDENTIAL ADDRESS

THE RELATION OF "THE SCIENCES" TO PHILOSOPHY

Rev. Richard B. Schmitt, S.J.

All science has for its object the explanation of facts, that is, the discovery of their reasons for existing, or as the Scholastics say: Science is the knowledge of things through their causes. To have a scientific knowledge of a thing, one should know the material cause: of what a thing is made; the formal cause: what the thing is; the efficient cause: by whom it has been made; and the final cause: the

end for which it was made. In the abstract sciences, where there are no material substances, the causes and effects are represented by principles and conclusions.

Every science is knowledge, but not all knowledge is science. Science is distinguished from mere knowledge by certitude, and that certitude must be comprehensive and systematic. Science goes beyond the appearances of things, it is the knowledge of the causes and the laws. Merely to gather together materials is not the construction of a building. Thus isolated facts and propositions, without being connected, are the matter of science, but not science itself.—Principles are the bonds of propositions, and laws are the bonds of facts. One deduces propositions one from another and then connects them by reason. One systematizes the knowledge of individual beings and particular facts by connecting them to some constant relation of coexistence or succession. It is to this rational connection that particular truths form a coherent whole and become a scientific structure, the parts of which firmly strengthened among themselves mutually sustain and explain each other. That which produces in science this essential connection, which makes for strength and unity, is method. Thus the mathematician connects by a series of deductions the multiplicity of theorems to the demonstration, the axiom and the definition. The physicist and the chemist recall, by an assemblage of deductions, the variety of the particular facts to the unity of the laws which govern them.

The ordinary uneducated man has a number of particular ideas, more or less incoherent; it constitutes a mass, but not an ordered whole. It is then by the quality of coherence and generality that science differs from ordinary knowledge.

Science has numerous advantages since it gives us useful knowledge, that is, to understand a thing and explain it, is to point out the reason for its existence, which includes their causes, their principles and their laws. A physical or biological phenomenon is explained when the physicist or naturalist can point out the causes which produce it and the law according to which the cause operates. The power of man over nature is gauged by the extent of his knowledge; since to produce or to prevent a phenomenon it is necessary to know its cause. Science permits us to provide for the necessities of life by making known the causes, the docile instruments of our actions.

Perfect science, the synthesis of all particular science, would be the universal and adequate knowledge of the universe. This is the privilege of God alone. Man, not being able to attain this objective, is obliged to divide his knowledge in order to state them precisely and to have them at his command, and hence we have the particular sciences.—At first there was only the one science having for its object the universality of things. The first philosophers called it wis-

dom; but Pythagoras termed it philosophy, the love of wisdom or the love of knowledge. Gradually the particular sciences became separated from "this philosophy." Mathematics was the first to mark out for itself an independent sphere. Then, in the Middle Ages and after, we have a new science, physics, which also detached itself from philosophy. The great physicists of the seventeenth century Galileo, Descartes, Pascal, Newton were great philosophers as well as scientists. It is only towards the end of the eighteenth century that physics had a method of its own. Then came in rapid succession chemistry, physiology, biology and the rest of the modern sciences. In proportion as the precision of the analyses advances, each of the sciences itself tends to be subdivided into special sciences. While remaining quite distinct the sciences intertwine and so are a mutual support to each other; e.g. there are questions in physics that depend on mechanics: thermo-dynamics; others depend on chemistry: thermo-chemistry; others on physiology: optics and acoustics. History and geography are closely related; and medicine necessarily depends on physics and chemistry. A good example of correlation of three major sciences we find in the various divisions of chemistry: here we have physical-chemistry, bio-chemistry and now bio-physical-chemistry.

Consequently at present we have a long list of sciences all of which emanated from philosophy; a fact often lost sight of. So we might try to classify and correlate all the sciences of the present day in order to get a comprehensive view of the relationship that exists between "the sciences" and philosophy. To classify all the sciences would be to list them in distinct and subordinate groups and determine the bonds that unite them so as to show which position they occupy in the epitome of human knowledge. Such a classification should be made according to the nature of the objects known and not according to the faculties of the subject thinking. By following this natural order, the classification shows: the unity and diversity of human knowledge, the proper realm of each science, and the logical bonds which unite the sciences to each other.

We might recall briefly a few of the classic classifications that we find in literature. Aristotle classifies the sciences according to the possible forms of human activity, namely: speculative (physics, mathematics and metaphysics); practical (ethics, economics and politics); and poetical (poetry, rhetoric and dialectics). This classification is incomplete, it merely corresponds to the three modes of an intelligent being: to know, to act and to produce. Of course it must be remembered that, at that time philosophy was considered the universal science.

Francis Bacon takes as the principle of his classification of the sciences the intellectual faculties from whence they proceed. According to him the mind has three essential functions: to conserve, to re-

produce and to combine; to which correspond the three faculties of memory, imagination and reason. Hence the three main divisions of the sciences are: Science of the memory: history (natural and civil); science of the imagination: poetry (narrative, dramatic and parabolic); and science of the reason: philosophy: God, nature (physics, metaphysics and mechanical arts), man with his body, his soul and his social relations. . . . D'Alembert adopts this classification with one exception, he places reason before the imagination. . . . The principle of this classification does not seem justifiable, because our faculties do not operate separately and no science is the exclusive work of one faculty. It is an axiom: the study of each science calls all the faculties of the mind into operation.

The Scholastics divide human science into: grammar, dialetics, rhetoric; and music, arithmetic, geometry and astronomy. These constitute the Seven Liberal Arts. Canon law, civil law, medicine and theology were placed in a different category and on a higher plane. It is clear that this is not a classification but a plan of studies which contains only a simple enumeration.

Herbert Spencer distiguishes the sciences in this manner: Abstract sciences: these have for their object the relations that exist independently of phenomena and of real beings: logic and mathematics. Abstract-concrete sciences: they have for their object the phenomena which are independent of the beings that produce them; mechanics, physics and chemistry. Concrete sciences: which have for their object the beings themselves: astronomy, geology, biology, physiology and sociology. This classification is based on the principle of the increasing complexity of objects and their decreasing generality. Furthermore it gives no special place to ethics and omits entirely metaphysics.

We will now give a classification of the sciences that is worthy of our consideration and demonstrates clearly the relation of "the sciences" to philosophy. It is the classification proposed by Gaston Sortais, S.J. He places above all the sciences, dominating them by its supreme abstraction, general metaphysics —which is the science of the first principles of all knowledge and of all our being. The purpose of the critique is to determine clearly the value of knowledge. The subject matter of ontology is "ens ut sic," being in its universal properties. The sub-divisions are based upon the nature of the objects studied and upon the order of their increasing perfection.

I. Mathematical sciences: have for their object magnitude or quantity considered exterior to the things themselves.

Geometry, the science of figural extent,
Arithmetic, the science of numbers,
Algebra, the science of exemplified and generalized magnitude.

Calculus (differential and integral), complements higher algebra,

Mechanics, the science of the laws of equilibrium and motion,

Astronomy, the science of the distance of the celestial bodies and their motion.

The last two, mechanics and astronomy, are not purely abstract like the others but mixed, that is to say, they have placed among the abstract sciences and also among the concrete because they have the starting point in observations and they employ calculus in computing their problems

II. Physical sciences: they have for their object inanimate beings.

Geology, the science of the constitution of the earth,

Physical geography, the science of the description of the earth-surface,

Mineralogy, the science of the minerals,

Physics, the science of the general properties of matter,

Chemistry, the science of the intimate structure of matter and the compounds which manifest particular properties.

III. Biological sciences: they have for their object living beings, plants and animals.

Paleontology, the science of fossils,

Botany, the science of plants,

Zoology, the science of animals,

Botany and zoology are subdivided into:

Anatomy (plant or animal) the science of organs,

Physiology (plant or animal) the science of functions,

Pathology, the science of disorders of the organs and functions,

Ethnology, the science of the origin and distribution of the races.

IV. Moral sciences: they have for their object man, as an intelligent and free being. But man can be considered individually or in his relations with other men, hence the two groups of moral sciences:

A—Psychological sciences: which study the human mind either in conscious deeds which manifest it, or in tendencies towards the good, the true and the beautiful. Therefore:

Experimental psychology: the science of the phenomena of consciousness,

Logic, the science of truth,

Ethics, the science of duty,

Esthetics, the science of the beautiful.

B—Social or political sciences: which consider man in his divers relations with other men, hence:

Philology or linguistics, the science of language,

Political economy, the science of wealth,
Law, the science of the relations of citizens among themselves,
Politics, the science of the relations between the government and the governed,
International law, the science of international relations,
History, the science of the events of the past life of man and the laws which regulated them.
Political geography, the science of the description of nations.

V. Metaphysical sciences: they have for their object the intimate nature of beings; and beings can be subdivided into the world, the soul and God; hence
Rational cosmology, the science of the nature of bodies,
Rational psychology, the science of the nature of the soul,
Rational theology, the science of the nature of God.

This classification is founded on the nature of the objects to be known; it proceeds from the exterior to the interior; it sets out from exterior facts: extension, physical phenomena, then it passes to interior facts: biological and psychic phenomena; finally, it arrives at what is most ultimate, the nature, the essence of beings, that is to say, of matter, of the soul and of God. It follows too, the order of increasing complexity. Lastly, it indicates the increasing perfection of objects of knowledge, for it begins with the study of abstractions, passes on to the study of inorganic matter, continues with the study of vegetable and animal life, then to psychic and social life; finally it mounts to the study of the nature of the world, the soul and God.

Each science then tends towards certain general truths, corresponding to its proper object. However, the universe is one and the mind seeks to discover this unity. There is then a science of sciences which coordinates all our knowledge and organizes it into one vast system, and this science is philosophy. Of course, each science may have its own philosophy; for when a science endeavors to give an account of its basic ideas, its principles and its methods, and particularly when it aims at giving reasons for the general results, attempting to unite them, to show their relations with other sciences, then it ascends to philosophy.

The relation of philosophy to the sciences is readily seen in this: philosophy provides physics with the idea of motion, of force, of cause and effect, of substance, of law, as well as the principle of causality, substance and finality. Then too, physics aids the philosopher to study exterior perception; chemistry is of service to him in determining the physical essence of bodies, the various properties of substances and the classification of these substances and also shows the difference in the elementary forms of matter. Philosophy provides

the biological sciences with the idea of life, of species, of means and of end, as well as the principles of causality and finality. In turn. physiology serves the psychologist in regard to sensation, memory, imagination, the passions which depend more or less on certain physiological changes on account of the mutual influence of the physical and the moral. Furthermore the marvellous organization of living beings is the foundation of the argument of final causes in theodicy.

We all will agree that the so called "sciences" are intimately related to philosophy. Most of us, who are teaching chemistry, are approached each year by the professors of philosophy and are asked to define and explain: an electron, a proton, an atom, a molecule; or what is the Rutherford-Bohr theory of the atom, how does this differ from the Lewis-Langmuir conception of the atom, etc. Similar questions are asked in physics and biology. It seems that it would be a helpful plan to ask the professors of philosophy what scientific words they would like defined and what theories explained, so that they could use these in their notes to the students. After all, this list would not be very long, since there are not a great many of these used practically in our courses of philosophy. A competent committee might be appointed to propose this question at the meeting of the philosophers and then acted upon accordingly. It is true, that some of the modern theories are changing as time goes on, but it would be unreasonable to ignore them. New facts are being discovered constantly and we cannot reject these facts, and as scientists we must carefully weigh and consider the discoveries and theories of renowned and distinguished scientific men. This plan would stimulate helpful discussion and if successful, give unity to our teaching methods.

On Monday, August 12th, at 9:00 A. M. and at 3:00 P. M., and on Tuesday, August 13, at 9:00 A. M., the various sections held their separate meetings.

FINAL GENERAL SESSION

On Tuesday, August 13th, at 1:00 P. M. the final general session was held in the Chemistry Lecture Room. Fr. Morgan was invited to relate a few of the impressions made upon him by the convention, and he responded by commenting most favorably on the character and amount of work being done by the members of the Association,—particularly mentioning the research work done in chemistry. He urged all the members to instill the idea of Research Work into students' minds, and to instill such ideas early in the scolastic careers of the students. At the end of his address Fr. Morgan was unanimously elected, on the motion of Fr. Coyle, an honorary member of the Eastern Division of Jesuit Scientists.

The reports of the secretaries of the different sections showed that the following officers had been elected for the coming year:—

Biology:	Chairman, Rev. John A. Frisch. Secretary, Mr. James L. Harley.
Chemistry:	Chairman, Rev. G. F. Strohaver. Secretary, Mr. Edward S. Hauber.
Mathematics:	Chairman, Rev. F. W. Sohon. Secretary, Mr. G. P. McGowan.
Physics:	Chairman, Rev. T. J. Love. Secretary, Mr. William D. Sheehan.

Next followed the report of the Committee on Resolutions. Fr. Hohman read the following resolutions, which were accepted as read:

The American Association of Jesuit Scientists, Eastern States Division, assembled at its Eighth Annual Meeting at Holy Cross College, presents the following resolutions:

1. We extend our most cordial thanks to Reverend Father Rector, Father Minister, and all the members of the community of Holy Cross College for the splendid arrangements made for our comfort and entertainment.

2. We express our heartfelt appreciation for the constant encouragement shown the Association by our various Fathers Provincial.

3. We view with great satisfaction the increasing interest in science shown by our younger members.

4. While we recognize the growth in the amount of research done by our members, we urge a more general participation in this important activity.

5. We present our heartfelt gratitude to the outgoing officers of both of the general association and of the various sections, and we pledge our hearty co-operation to the incoming officers.

6. And be it further resolved,

That the sincere gratitude of the entire association be extended to Father Gipprich for his efficient and untiring labors for the past success of the Bulletin and to Mr. Lawrence Gorman, of Georgetown University for the generous assistance rendered.

The President, Fr. Schmitt, had prepared a mimeographed List of Topics to be discussed at the final General Session. These Topics were now discussed:

1) Should there be special numbers of the Bulletin?
A majority vote decided against special numbers.

2) How many issues of the Bulletin per year?
A majority vote decided that the plan of printing the Proceedings and three issues of the Bulletin per year should be continued.

3) Should the Secretaries continue sending Postals?
   A majority vote decided in the affirmative.

4) Should a Committee be appointed to draw up and send to the Philosophers' Association a report outlining the fundamental theories which are being taught by the Science Departments, in order that both the Science Professors and the Philosophy Professors might agree to teach the same thing in our Lord?
   A majority vote decided that the President of the Science Association should send a letter to the President of the Philosophers Association to find out the mind of the Philosophers Association in the matter.

5) The Chairman then called on Fr. Frisch for his report on the advisability of forming a Lay Professors Science Association.
   Fr. Frisch reported that about 35 Lay Professors, out of 180 to whom he sent letters, were strongly in favor of forming such an Association. This subject will be brought up again at the next annual meeting.

6) Should the abstracts of papers be given to the Secretary as soon as the paper is read? Decided in the affirmative.

◈ ◈

A Program Committee, consisting of the Chairmen of the different sections was appointed to prepare a program for the next annual meeting.

◈ ◈

After the completion of the above-mentioned business, the election of the new officers of the Association was held:

Father Richard B. Schmitt was unanimously reelected President.

Mr. Joseph T. O'Callahan was elected Secretary-Treasurer.

◈ ◈

The meeting was adjourned on a motion made by Father Love and seconded by Father Power.

◈ ◈

At a meeting of the Executive Committee Father Joseph P. Merrick was appointed Editor of the Bulletin. And the following members were admitted to the Association:

George H. Bahlman, S.J.
Anthony S. Carroll, S.J.
Joseph J. Molloy, S.J.
Edward S. Hauber, S.J.
James D. Loeffler, S.J.

The following members of the Association were present at this Convention:

Ahern, Rev. M. J.
Bahlman, G. H.
Berger, C. A.
Berry, Rev. E. J.
Brock, Rev. H. M.
Brown, Rev. T. J.
Cusick, Wm. H.
Carroll, A. S.
Coyle, Rev. Geo. L.
Didusch, Rev. J. S.
Freatman, H. L.
Frisch, Rev. J. A.
Gorman, L. C.
Harley, J. L.
Hauber, E. S.
Hohman, Rev. A. J.
Kelley, Rev. J. M.
Langguth, Rev. A. B.
Loeffler, J. D.
Logue, Rev. W. G.
Love, Rev. T. J.
Lynch, Rev. J. J.
MacCormack, A. J.
McCauley, Rev. D. V.
McGowan, Geo. P.
McNally, Rev. H.
Merrick, Rev. J. P.
Molloy, Jos. J.
Morgan, Rev. E. J.
Murray, J. L.
Nuttall, Ed. J.
O'Callahan, J. T.
Pollet, H.
Power, Rev. F. W.
Quigley, T. H.
Reardon, Rev. F. X.
Roth, Rev. C. A.
Schmitt, Rev. R. B.
Shaffrey, Rev. C. E.
Sheehan, W.
Smith, Rev. J. P.
Strohaver, Rev. G. F.
Sullivan, Rev. J. J.
Tobin, Rev. J. A.

ABSTRACTS

BIOLOGY

The Life History of Ammobia Ichneumonia, Linn.

REV. JOHN A. FRISCH, S.J.

Previous to the study reported in this paper, only Packard and the Peckhams had written about Ammobia ichneumonia, formerly known as Sphex ichneumonia. Checking their story it soon became evident that their reports were very superficial and contained inaccuracies and mistakes. As a result, two entire summers were devoted to a study of this wasp, as found at Woodstock College.

The wasps made their appearance during the first week of June. The first nests were observed during the third week of June, and the nest-building continues until the third week in September. These nests are built in the ground. They consist of an entrance tunnel, about a quarter of an inch in diameter, which extends into the soil at an angle of about eighty-five degrees for about five inches. From this branch tunnels extend at right angles for about one inch and then enlarge into cells, which are oval chambers one and three-quarters of an inch in length and three-quarters of an inch in width. On an average, three such cells are found to a nest, though one two-story nest of seven cells was found. Packard, and the Peckhams who copied his report, wrongly state that there is only one cell to a nest.

These cells are stored with a variety of grasshoppers, Orchelimum vulgare and gracile, Neoconocephalus ensiger and Conocephalus attenuatus. The number of individuals varies from an average of 3.7 per cell to individual cells containing as many as six. Packard and the Peckhams again wrongly state that only one grasshopper is stored in the cell.

These grasshoppers are immobilized, though not killed, by three stabs of the wasp's sting, one in the region of the suboesophageal ganglion and two in the region of the thoracic ganglia.

The egg is crescent shaped and about 6mm. long and 1mm. wide. It is glued to what we might call the throat of the first grasshopper deposited in the cell.

The egg hatches in about 48 hours. The larval period lasts 8 days though; as the end of the season approaches it is shortened to 5 days.

The cocoon consists of six layers of sile and the usual chitinous inner shell. The size of the cocoon varies with the size of the larva, being about 3.3cm. long and 1.2cm. wide for large larvae, and about 2.3cm. long and 0.9cm. wide for small larvae.

These cocoons remain in the ground all winter and hatch only in

the early days of June. However, in one case a male wasp hatched the same season, which might indicate two broods a season. This point requires further investigation.

Like all animals, Ammobia has her parasites. The following parasitic flies were recovered from nests, either as larvae or pupae: Metopia campestris (Fall), Metopia leucocephala (Rossi), and Senotainia trilineata (V. D. W.). Another interesting parasite, a species probably new to science, Dibrachys, n.sp., both male and female, were recovered from cocoons.

A large number of experiments were performed to test the intelligence of this wasp and to determine her stinging habits. Some of these are included in Mr. Edward G. Reinhard's recent book, "The Witchery of Wasps."

◈ ◈

Demonstration of the Skeleton in Small Vertebrates

REV. JOSEPH S. DIDUSCH, S.J.

Of the various processes for demonstrating the mammalian skeleton in situ, that of Charles H. Miller, Johns Hopkins Department of Embryology (Carnegie Institution of Washington), is the most satisfactory. The procedure is as follows:

1. Formalin material is washed overnight in water to which a few drops of ammonia have been added, in order to neutralize any acid that might have come from the formalin.

2. The specimen is then transferred to 70% alcohol, where it is left for from seven to fourteen days, the alcohol being changed daily for the first five days.

3. Thereupon it is stained with Lundvall's solution of toluidin blue:

Gruebler's toluidin blue,	1 gr.
Alcohol, 70%,	400 cc.
HCl,	4 cc.

4. Decolorized in acid alcohol:

Alcohol, 70%,	100 cc.
HCl,	1 cc.

It should be left in this solution for from seven to ten days, or until the alcohol is but slightly tinged with the stain.

5. Transferred to 80% alcohol, then to 95% alcohol, three days in each, in order to harden the tissues.

6. Transferred to a 2% solution of KOH in distilled water until cleared. With large specimens it is well to start with a 2% solution of potassium hydroxide, and after two changes increase the concentration to 3%. It may require seven days or more to effect complete clearing.

7. After the specimen is cleared it is passed through graded gly-

cerin, beginning with 20% and increasing 20% every two days. The larger the specimen the longer it should remain in each grade of glycerin.

8. Finally, the transparent specimen is mounted in pure glycerin to which have been aded a few crystals of thymol to prevent the formation of mold.

References

Schultze, O. 1897. Ueber Herstelling und Conservierung durchsichtlicher Embryonen zum Studium der Skeletbildung. Anat. Anz., Bd. 13 (Verhandl. der Anat. Gesellsch.), S. 3-5.

van Wijhe, J. 1902. A New Method of Demonstrating Cartilaginous Microskeletons. Proc., Koninklijke Akademie van Wetenschappen te Amsterdam, May 31.

Lundvall, H. 1904. Ueber Demonstration embryonaler Knorpelskelette. Anat. Anz., Bd. 25, S. 219-223.

Miller, Chas. H. 1921. Demonstration of the Cartilaginous Skeleton in Mammalian Fetuses. The Anatomical Record, Vol. 20, No. 4, March, 1921.

Further Hereditary Considerations

C. A. BERGER, S.J.

This paper was a summary of the evidence in support of the chromosome theory of heredity. The parallelism between the actions of the Mendelian factors and those of the chromosomes was brought out by reviewing the history of our knowledge of chromosomes. As a concise account of this history may be of some value, a summary of the important steps will be published in an early issue of the Bulletin.

The Penetration of Ultra Violet Rays in Living Tissue

J. L. HARLEY, S.J.

In the study of ultra violet rays and their relation to health, it is helpful to know: 1st, the SOURCES of these rays; 2nd, the MEDIA through which they are transmitted, and 3rd, their PENETRABILITY in living tissue. Accordingly we have grouped some of the latest findings in this subject under these headings.

The Sources are, 1st, the *natural*, i.e., sunlight, and 2nd, the artificial, i.e., the carbon arc and mercury vapor lamps, etc. Of all the sources examined, the spectral energy of the carbon arc is the closest approach to sunlight, but even this is not an exact match of sunlight in spectral intensity. (Cf. Bulletin 140 U S. Bureau of Standards.)

Media. Ordinary window glass will not transmit the ultra violet rays. However, there are now on the market several kinds which

do allow the rays to pass through. In regard to this special glass, we read in Science for October, 1928: "For workers and school children a few minutes' walk outdoors at noon will be more beneficial than all day spent in a room with ultra violet light transmitting windows."

Penetrability in LIVING tissue. Experiments conducted by Macht, Anderson and Bell at Baltimore have definitely established that the penetration of ultra violet rays through living skin and other tissue is much greater than has been hitherto supposed. For example it was formerly believed that the depth of penetration for the shorter ultra violet rays was less than 0.1mm., while in these experiments it was found that wavelengths of 3,025 angstrom units not only penetrate into a layer of skin 1mm. or more in thickness, but actually pass through it. C. B. Heald, writing in the British Medical Journal for January, 1929, gives a list of 27 diseases in which he feels that ultra violet therapy is of value. In only seven of these is his estimate of value as high as 75% or more, namely: bursitis, burns, debility, forunculosis, tuberculous glands, lupus and rickets.

◈ ◈

The Habitat of Mosses

HAROLD FREATMAN, S.J.

Starting from Fall and extending through the Winter, Spring, Summer, and back again to early Fall, the habitat of Mosses indigenous to the woods around Woodstock was described. Late Fall and Winter displays the Fissidens and Anomodon minor. Early Spring brings Bartramia pomiforms and Physcomitrium turbinatum and The Mniums, while late Spring gives us the Funarias and Bryums. In early Summer the Polytrichums are common in dry places. Later we find the Ditrichums and Hypnums of all varieties, as imponens, splendens, boscii, reptile. Prettiest now is the fern moss.

Back to Fall we come upon an abundance of species, especially if the weather is favorable. Look, and you will easily see and identify Plagiothecium denticulatum, Brachythecium starkei, Leucobryum glaucum silvery and soft. Tall and treelike is Climacium and americanum. Apart from the others in their characteristics are Entodon cladorrhizans and seductrix. Sphagnum is well known to botanists in swampy places. Now the Catharineas can be seen everywhere, and so, too, the Dicranums, acoparium and flagellare. As all the others dry up Ceratodon purpureum covers and barren places. And so we complete a cycle of Moss life as witnessed at Woodstock.

CHEMISTRY

"The Decomposition of Sucrose."

Rev. R. B. Schmitt, S.J.

This paper announced that the chemical properties mentioned in organic text-books were usually very few; although glucose and fructose were treated more fully.

Decomposition of sucrose takes place in the cane: in overripe cane, when allowed to stand in the fields after maturity; also, canes after being cut, and kept in the field or under shelter deteriorate very rapidly. This part of the decomposition of sucrose was not treated.

1. Decomposition of sucrose solutions on boiling:
   Sucrose solutions on prolonged boiling, under atmospheric pressure decompose into equal parts of glucose and fructose. The material composing the vessel exerts a considerable influence on the rapidity of the transformation. High pressure also makes for rapidity of the reaction, as does live steam at 130° C. Besides glucose and fructose many organic acids are formed as by-products. The maximum decomposition temperature has been determined to lie between 110° and 120° C.

2. Decomposition of Sucrose by light:
   Ultra-violet rays separate a gas in proportion to the concentration of invert sugar. Light frees carbon dioxide from fructose and carbone monoxide and hydrogen from glucose.

3. Decomposition of Sucrose by Dilute Acids:
   Dilute acids exert a hydrolysing power on sucrose. Invert sugar is formed and the plane of polarization is inverted to the left. The velocity of this inversion is shown to depend on certain laws.

4. Inversion Constants of some Acids:
   The Deerr method for determining the inversion velocity is described and the constants found are given.

5. Inversion power of Salts:
   Many salts invert sucrose at the boiling point of the solution. This power does not increase in proportion to the concentration.

6. Action of Concentrated Acids:
   Mineral acids of high concentration decompose sucrose. The decomposition products of several of these reactions are given.

7. Action of Alkalies and the Alkaline Earths:
   These decompose sucrose only when heated with them in the concentrated state. Decomposition products are given. Moder-

ately strong solutions of alkalies and alkaline earths combine with sucrose to form the saccharates.

8. Decomposition of Sucrose by Oxidizing Agents:
Powerful oxidizing agents readily attack sucrose. Fehlings solution attacks sucrose solutions very slowly. Ammoniacal silver nitrate upon heating. Free oxygen does not attack sucrose; finely granulated bone-black under certain conditions caramelizes sucrose. Ozone oxidizes alkaline or acid solutions. Hydrogen Peroxide inverts sucrose in the presence of iron salts, and then oxidizes the invert sugar.

9. Decomposition of Sucrose by Ferments:
Every species of yeast contains a ferment that transforms sucrose into invert sugar. Lactic acid bacteria transform sucrose in the presence of lime into lactic acid; carbon dioxide and hydrogen are by-products.

The Determination of Beeswax in Candles

EDW. S. HAUBER, S.J.

Liturgical candles, according to a decree issued on Dec. 14, 1904, by the Sacred Congregation of Rites, should contain beeswax "saltem ex maxima parte" which is interpreted to mean at least 51 per cent. The other 49 per cent may be made up of any suitable candle material, but stearine, i. e. commercial stearic acid, and paraffin usually make up the non-beeswax content. When these three substances are mixed it does not seem possible to separate them, for any solvent suitable to dissolve completely one substance also dissolves parts of the others, thereby preventing complete isolation. Wherefore an indirect method by means of the "ester number" must be employed to obtain the percentage of beeswax, stearine and paraffin in a liturgical candle. The "ester number" is nothing more than the result when the acid number is subtracted from the saponification number. As the ester number of beeswax given in the literature varies generally from 72-77, so also may an analysis of a candle vary, depending on which ester number is used. For example a candle giving an analysis of 51 per cent beeswax when the ester number 72 is used, may be regarded as having 47.8 per cent if the highest ester number, 77, is employed. However when analysing a liturgical candle of doubtful beeswax content the benefit of the doubt must be given to the manufacturer and the lowest ester number, 72, allowed by the U. S. P., should be used

The presence of stearine and paraffin may be detected by their characteristic tests. Knowing that paraffin is entirely unsaponifiable and that the saponification number of stearine is equal to the acid number

we may state the fundamental equation for determining the percentage of beeswax, stearine and paraffin in a liturgical candle.

$$\overset{a}{\text{Sap. No. Bswax}} \times \overset{x}{\%\text{Bswax}} + \overset{b}{\text{Sap. No. Stearine}} \times \overset{y}{\%\text{Stearine}} = \overset{r}{\text{Sap. No. Candle}}$$

$$\overset{c}{\text{Acid. No. Bswax}} \times \overset{x}{\%\text{Bswax}} + \overset{b}{\text{Acid. No. Stearine}} \times \overset{y}{\%\text{ Stearine}} = \overset{q}{\text{Acid No. Candle}}$$

Subtracting the lower from the upper equation

$$ax + by = r$$
$$cx + by = q$$

$$x\,(a-c) = r-q \qquad \text{or} \qquad x = \frac{r-q}{a-c}$$

x Percentage of beeswax in the candle.
a Saponification number of beeswax given in the literature.
c Acid number of beeswax given in the literature.
r Saponification number of candle obtained by analysis.
q Acid number of candle found by analysis.

The amount of stearine in the candle is found by substituting the analysed percentage of beeswax in the fundamental equation given above and solving for y, the unknown. The percentage of paraffin is obtained by subtracting the sum of beeswax and stearine from 100 per cent.

The saponification number of the candle was found by boiling 2.5 gram samples with a blank in about 30cc. of approximately normal sodium ethylate for 3 hours. The samples and blank were titrated hot with approximately normal standard HCl using phenophthalein as an indicator.

The acid number of the candle was determined by dissolving about 5 gram samples in 250 cc. of neutral 95% alcohol and titrating hot with N/10 aqueous standard sodium hydroxide with phenolphthalein as the indicator.

Owing to the variations in the "constants" of genuine beeswax the analysis should be guaranteed closer than 5% at best.

The presence of other adulterants (i.e. aside from stearine and paraffin) can usually be detected by qualitative tests, by close observation of the sample during the process of analysis, and by interpretation of the analytical data.

Quantitative Reactions in Acid and Basic Analysis

REV. G. L. COYLE, S.J.

The speaker described some research work done by candidates for the M. S. degree in the Georgetown Chemical Laboratories. An attempt was made to determine the quantitative value of the separation of various acids from each other by the reagents, Calcium Nitrate, Barium Nitrate, Zinc Nitrate and Silver Nitrate, and the effect of hot and cold filtration was noted. In Group I separations, borates varied from 49.8% to 54.2%, according as the filtrate was hot or cold. Arsenites gave 81.8% to 82.9% under the same conditions, but arsenates varied from 70.6-80.2%. Phosphates and oxalates were quantitatively precipitated.

In Group II, both sulphates and chromates were precipitated quantitatively. In Group III, ferrocyanides gave results above theoretical, while ferricyanides gave only 91.5% of the theoretical yield. Group IV members were precipitated quantitatively, though sulphocyanides tended to give high percentages unless well washed. The group reagents used previously had no effect on the halogens or sulphocyanides.

In an investigation into the sensitivity of various analytical tests for nickel and cobalt, it was found that the group reagent separated enough of these metals to prevent their interference with subsequent tests, and that the amount precipitated would furnish sufficient material for further treatment, and that the test reactions were sufficiently sensitive to separate and identify less than the amount of the substance usually given to students for analysis. The conclusion drawn from quantitative identifications was that Vogel's reaction is undoubtedly the most sensitive test for cobalt, and compares favorably with the dimethyl glyoxime modification in which bromine water is used when testing for nickel.

Experiments in Fire Polished Glass

REV. J. J. SULLIVAN, S.J.

A strong beam of light passing through a room shows an enormous number of motes present in the air. In the same way a beam of light from an arc passed through a glass container holding water shows an immense number of tiny particles floating therein. It is estimated that even in distilled water there are about 25,000 to the square inch. Some of these motes come from the air, but many also come from the walls of the container and are sloughed off as the glass ages. If a glass container is fire polished, however, the number of motes can be diminished to a negligible quantity. By fire polishing is meant a resurfacing of the container brought about by melting the whole

container in a hot flame and once more blowing it back into its original shape. Such a container, if used as a receiver in a distillation carried on "in vacuo" in such a way that no boiling occurs, will not slough off these tiny particles of silica for a long period of time.

To show the difference between a fire polished surface prepared as above and an etched surface such as occurs in a container which has been cleaned in highly corrosive cleansing solution (like sulphuric chromic mixture), various experiments have been carried on at Johns Hopkins University. Some experiments involved a chemical change where undoubtedly the etched wall of the glass container had some catalytic effect and others were studies along the lines of vapor pressure measurements. In the study of vapor pressures evidence has been obtained which shows almost conclusively that the layer of molecules in the gaseous phase absorbed by the walls of the glass container is only one molecule thick. This was true for pyrex glass and also for quartz containers.

◈ ◈

The Electric Bomb Method for the Determination of Halogens in Organic Compounds

LAWRENCE C. GORMAN, S.J.

The sealed tube method of Carius for the determination of the halogens presents several difficulties which are well known to those who have used the method.

The comparative ease and handiness of the Sodium Peroxide Method, when performed in an electrically ignited Parr Sulphur Bomb, prompted a description of the method, which the writer found outlined in the Journal of the American Chemical Society, Vol. 39. 2069-2074 (1917).

Results of some determinations made by graduate students at Georgetown on Organic compounds containing Chlorine, Bromine and Iodine, showed that their best results did not vary more than .5% from theoretical, a fact which seems to indicate that the method is a reliable one when followed accurately. In actual operation the method is simpler, less expensive and more conveniently executed than the sealed tube method of Carius.

PHYSICS

The Nature and Origin of Cosmic Rays

REV. H. M. BROCK, S.J.

Cosmic Rays consist of radiations of extremely small wave length which penetrate our atmosphere from interstellar space. The first evidence concerning them was obtained in 1901, when Elster and Geitel, and also C. T. R. Wilson observed that air, even when completely enclosed, became slightly ionized and capable of discharging an electroscope. The effect persisted even though all radio-active substances were eliminated, though it was diminished by increased shielding. It was first suspected that the radiation causing this ionization was terrestrial in origin. However, balloon observations by Hess in 1911 and 1912 showed that the effect increased with altitude, being two to three times as great as 5,000 meters as at sea level. He concluded that the radiation was cosmic, coming from outer space. Kohlhoerster later sent up balloons with improved apparatus as high as 9,300 meters and found an increasing effect. Millikan sent up balloons with recording apparatus in Texas to a height of 15.5 kilometers. To determine absorption effects he made studies on Pike's Peak and later in the waters of certain lakes. He sunk his electroscopes in Lake Muir, at the foot of Mr. Whitney, and later in Arrow Lake. Including atmospheric absorption he found that a layer equivalent to 22 meters of water was necessary for complete absorption. This is equivalent to 1.83 meters of lead. The rays were found to be one hundred times as penetrating as X-Rays. The absorption coefficient was .04 that of gamma rays.

Recently Millikan and Cameron have made further studies in Lake Miguilla in Bolivia in the Andes for the purpose of obtaining additional data concerning the geographical direction and spectral distribution of cosmic rays. Important results were obtained. The intensity of the rays at sea level was shown to be such as to give an ionization equivalent to 1.4 ions per cubic centimeter per second. Two sets of night and day observations of three days' duration in the deep valley showed no difference between the radiation coming from the plane of the Milky Way and the plane normal to it. The distribution was independent of geographical position. Several spectral bands exist, though most of the rays consist of two bands three octaves apart. The shortest wave length was found to be .00008A. The total energy of cosmic rays is estimated as nearly one-tenth that of star light.

The origin of cosmic rays is not known with certainty. Millikan supposes that they are caused by nuclear atomic changes in space.

The fact that several spectral bands exist would require these nuclear changes to have sharply defined energy values which may be translated like quantum jumps into spectral line frequencies. Now there seem no transformations capable of producing rays of such penetrating power except those which correspond to the production of elements like helium, oxygen silicon and iron from hydrogen. Indeed, Aston's data and Einsten's energy equation seem to indicate that these are the only ones possible. It is not likely that the rays originate in the stars, for in this case the suns should also send them in abundance. It is more likely they come from interstellar space where the nucleus building is favored by low temperature and density If these views are shown to be true we would apparently have evidence that not only is atomic disintegration going on in the universe but also the building up of atoms. This must give rise to difficulties against the second law of thermodynamics. Millikan and Cameron suggest that, while the law remains intact for all purposes on a small scale, it may not hold true as applied to the universe.

◈ ◈

Atmospheric Electricity During the Dust Storms in the North of China

Rev. H. Pollet, S.J.

Our observations were made at Tientsin. The results, however, can be applied to the whole plain of Chih-li. This plain would be a true desert without the two months of rain due to the Summer monsoon. The strong winds of Winter and Spring, blowing on a dried land, lift easily a great deal of dust. But it is not only the local dust which is moved by the wind. The winds coming from Mongolia often carry real clouds of yellow dust which, after a trip of 600 miles, flood the country.

As the fine particles rub against bodies of all sorts that they meet, grains of dust thus transported are charged with negative electricity This phenomenon takes place on a large scale with automobiles, which are driven through dusty air. The chassis, insulated from the ground by the rubber tires, is strongly charged electrically. The negative charge of the dust has the effect of reversing the electric field of the atmosphere. Variations were recorded photographically with a quadrant electrometer As soon as a dusty wind comes up, the potential falls to negative values, sometimes considerably, and in only a few minutes.

Before, during and after the dust storms, there is a great deal of static. This static was registered photographically with a radio tube and a galvanometer.

The average charge of a dust particle was found to be about 4.4×10^{-8} electrostatic units, that is to say, about one hundred times more than the charge of an ion.

The Development of the Compass

T. J. Love, S.J.

The discovery that a lodestone, or a piece of steel touched with a lodestone, will always direct itself to a N—S position and the application of that discovery to direct the navigation of ships have been attributed to and claimed for many nations. The Chinese, the Arabs, the Greeks, and the Etruscans have all been hailed as the originators of the compass, yet no positive records can vindicate, for any country, an antiquity much earlier than the eleventh century.

From the earliest times the magnetic compass was either of the floating or of the pivoted type. For many centuries hardly any improvement is noted. But at the beginning of the seventeenth century, a much needed and permanent improvement was made. This improvement was the suspension of the compass and card on gimbals or rings at right angles to each other. The gimbals allowed the needle to maintain a horizontal position, no matter what the pitch or roll of the ship.

During the eighteenth and nineteenth centuries, as the knowledge of magnetism increased, an increase in the accuracy of directing ships was also obtained. This, however, was offset to such an extent by the building of steel ships and the shipments of iron cargoes, that the ships were thrown many miles off their plotted courses. A new and accurate means of directing navigation was imperative. The need was supplied by the invention of the Sperry Gyro-Compass.

This compass differs in principle from that of any other compass. It is not magnetic. It derives its directive force not from magnetic attraction but from the earth's rotation. Briefly the principle is this: Any wheel rotating at a high speed about its own axis and free to place itself in any plane is called a gyroscope. If one were to place such a wheel, supported by its axis, upon a larger wheel, also rotating very rapidly, the larger wheel would so influence the smaller one, that the axis of the smaller wheel would point in the same direction as the axis of the larger one. In the case of the Gyro-Compass, the larger wheel is the earth, and the smaller wheel the wheel of the compass. This compass invariably points to the true geographic north.

The third type of compass is called the earth-inductor compass. It is of somewhat recent development, but was used by Lindbergh on his famous flight. In this compass the conductor consists of a rectangular armature which is driven by a windmill. The magnetic lines of force which are cut are those of the earth's magnetic field. The E. M. F. generated by the armature depends upon the position of the brushes in relation to the direction of the magnetic field. The working of the compass hinges upon this fact: the potential depends upon the angular relation between the brushes and the direction of

the earth's magnetic field. The indicator, or compass head, is simply the needle of a sensitive galvanometer, the position of which indicates the relative amount of E. M. F. generated. Operating at normal speed the generator output will be sufficient to cause a deflection of the tip of the hand of the indicator of not less than .4mm. for a 1° departure from course, and a deflection of not less than 10mm for a 30° departure. The chief application of the compass is to aerial navigation.

◈ ◈

Are Molecules Actualities?

REV. J. P MERRICK, S.J.

The molecule of the physicist was defined. Brownian movement is spontaneous and eternal. Molecular theory can visualize this phenomenon. Imagine minute particles, constantly striking each other, acting as pure elastic bodies would in molor mechanics. Perrin conceived these particles in emulsion to obey the gas laws and exert osmotic pressure. Using LaPlace's equation for the distribution of pressures in a vertical column of gas: [$2/3 \log n^\circ/n = \frac{N}{RT} V (D\text{-}d)gH$ where N is Avogadro's number, V is the volume of the suspended grains, D the density of the grains, d the density of the liquid]—he found N ranged from 60 to 72×10^{22}. Volumes were varied 50/1, nature of grains and liquid varied, density varied 5/1, water was super-cooled and heated, changing viscosity 250/1. Moreover distribution of particles varied with H according to kinetic theory.

Assume now similar ultra-microscopic particles to exist. If several independent formulas built on this assumption give N is 60 to 70 × 10^{22} it is inconceivable that the assumption be false. But Brownian movement displacements, rotations, diffussion, Black body spectrum, Oil drop experiment, Radioactivity by 4 distinct formulas, kinetic theory of gases, X-ray spectra, critical opalescence, Blueness of sky, Light diffusion in argon, and the ratio of faraday to electronic charge, all give same result within experimental error. Osmosis and other gas-like phenomena of liquids, and the visible Brownian movement of solid aggregates in liquids and solids, prove liquids and solids also are molecular. For in such cases a solid continuum is inconceivable and a reticulum an unnecessary invention. Sublimation, thin films, vapor tension, X-ray patterns, coordination of structural formulas of thousands of compounds, and of atomic weights by mass-spectograph and vapor density, masses of H and O atoms by forked x-particle trails, amply prove and confirm this conclusion.

Thick Lenses

EDMUND J. NUTTALL, S.J.

The development of the formula for a thick lens follows the same method as that of a thin lens, with this difference: When the ray emerges from the second surface the object distance is not equal to p", but p"+t, where t is the thickness of the lens. Equating the values of p", as found by refraction at the first and second surfaces, an equation is obtained which may be put into the form of

$$\frac{1}{p'-\beta} - \frac{1}{p-\alpha} = \frac{1}{F}$$

where p' is the distance of the image from the second surface; p the distance of the object from the first surface and F the focal distance of the lens. The points α and β, measured from the respective surfaces of the lens, are termed the Principal Points of the lens, and planes passing through these points perpendicular to the principal axis are termed Principal Planes. Since α and β are constants for any particular lens, measurements are made from these points and not from the surfaces, as is the case with thin lenses. It may be noted that if we measure P' from a point at a distance, β in the positive direction from the second surface, and P from a point at a distance α in the positive direction from the first surface, we have $p-\alpha=P$ and $p'-\beta=P'$, and we may write the formula for a thick as

$$\frac{1}{P'} - \frac{1}{P} = \frac{1}{F}$$

a form similar to that of a thin lens.

◈ ◈

The Signification of Energy in the New Physics

JAMES D. LOEFFLER, S.J.

The current doctrine that matter and energy are interchangeable makes it pertinent to inquire into our definitions of mass and energy and the fundamental concepts they represent. An article by Fulton J. Sheen appearing in the July number of "The New Scholasticism" attacks the problem by distinguishing two modes of generalization for physical problems, viz., metaphysical and mathematical, the latter of which is of greater utility for physics. He bases his argument on St. Thomas, and, with Professor A. S. Eddington declares that philosophical implications, including the notions of "Substance" and "cause" can be prescinded from.

"Energy," in the New Physics, involves ideas not contained in the

definition: "the capacity for doing work." 1) Planck's Constant, "h," is an "atom of action" called "the energy of the four-dimensional world," and is a product of energy multiplied by time. The quantum is treated of as a particle, but essentially involves the wave theory, and ether continues to be a postulate. The Compton and Raman Effects throw interesting light on this subject, but the fundamental problem of the vast spatial dispersion of the quantum and its integral reception by an atom remains unsolved:

The electron is said to consist of pure energy, and its mass to be wholly due to the charge which it carries. This mass is derived from and measured by an analogous kind of inertia manifested in the property of self-induction of electric current, and varies with velocity at high speeds. Recent developments have extended to the electron some quantum aspects such as a wave motion of travel. This theory was first proposed by de Broglie, was developed comprehensively by Schrödinger, whose atom model has superseded that of Bohr, and has received experimental confirmation in the work of C. J. Davisson of the Bell Telephone Laboratories. It is probable that the electron consists of concentrated energy borne by ether waves.

Reasoning from the relation of volume to apparent mass of the electron, some investigators have concluded that atomic nuclei likewise consist of energy concentrations.

We may give due weight to the scientists' description of phenomena through mathematical definitions, without committing ourselves on the nature of things in themselves.

◈ ◈

Teaching the Slide Rule

T. H. Quigley, S.J.

On the Log Log Duplex Slide Rule let the length of the L scale (25 cm. on the smaller slide rule), be the unit of measurement.

Let n be the reading on the scale used.

Then, on the different scales, the distance (in terms of the unit above) measured from the left index to the reading "n" is as follows:

K	$1/3 \log n$	n varies from 1 to 1000.
DF	$\log n - \log \pi$	π to 10π.
D	$\log n$	1 to 10.
L	n	0 to 1.
LLO	$\frac{1}{2} \log_{10} (\operatorname{colog}_e n) + \frac{1}{2} \log_{10} 10$;	$e^{-0.1}$ to e^{-3};
	" " $+ \frac{1}{2} \log_{10} 1000$.	$e^{-0.03}$ to $e^{-0.1}$
A	$\frac{1}{2} \log n$	1 to 100.
LL3	$\log_{10} (\log_e n)$	e to e^{10}.
LL2	$\log_{10} (\log_e n) + \log_{10} 10$	$e^{0.1}$ to e.
LL1	$\log_{10} (\log_e n) + \log_{10} 100$	$e^{0.01}$ to $e^{0.1}$.

CF	same as DF.	
CIF	$\text{colog}\, n - \log \pi + \log 100$	$100/\pi$ to $10/\pi$.
CI	$\text{colog}\, n + \log 10$	10 to 1.
C	same as D.	
B	same as A.	
S	$\frac{1}{2} \log \sin n + \frac{1}{2} \log 100$	n varies from arc sin 0.01 to arc sin 1.
T	$\log \tan n + \log 10$	arctan 0.1 to arctan 1.

Since on the D scale the distance measured from the left index to the hairline of the indicator (placed at any point) equals the log n_d, and on the A scale this same distance equals $\frac{1}{2}$ log n_a

$\log n_d = \frac{1}{2} \log n_a = \log (n_a)^{\frac{1}{2}}$ $\quad \therefore n_d = (n_a)^{\frac{1}{2}};$ $\quad n_a = (n_d)^2$

where n_d is the reading on the D scale, and n_a is the corresponding reading on the A scale. In like manner from other combinations we may find all the expressions which may be read directly by means of the indicator without setting the Slide.

Moreover, since lengths measured in terms of the reading on one scale may be added to (or subtracted from) lengths measured in terms of the reading on another scale, and the sum (or difference) of the lengths may be read in terms of the reading on a third scale, a very large number of operations may be performed by means of the slide rule.

◈ ◈

Mathematics in the High School

W. H. Cusick, S.J.

During the last ten years a number of new ideas have been introduced into the mathematical courses of our secondary schools. Some of these have been beneficial both to the schools and to the pupils, others will need to be changed as time and experience may indicate. It is the purpose of this paper to discuss some of them, but before doing this it will be well to recall the purpose of teaching mathematics in the high schools. Briefly we may say that the purpose is two fold, disciplinary and practical.

Mathematics may be looked upon as a set of intellectual exercises. If properly used, these teach a boy to think clearly and accurately, to analyze complex problems and to recognize logical relations between interdependent factors. They train the intellect, and in doing so, earn the right to an important place in our classical course.

The reorganization of mathematics is not a local matter. It has been sponsored by the National Committee on Mathematical Requirements. This committee in its report for 1921 strongly urged certain changes. Publishing houses have rewritten their text books, and the schools have altered their courses. These changes have been in ef-

fect for 5 or 6 years, so we may look for results. The first thing to note is that the time allotted to the study of mathematics has been cut down from five years to three and one-half. Ten years ago a boy who wanted an A.B. degree studied algebra, plane geometry and solid geometry for four years in High School, and studied trigonometry and analytical geometry for one year in college. Today trigonometry is taught in the High School, and geometry, both analytical and solid, is no longer studied. Usually the course is followed during the first three and one-half years in High School. There is a lapse of two and one-half years between the end of this course and the course of Physics in the Junior year of college. If this were the only disadvantage we might overlook it, but there is another and a greater one.

The reorganized system affected the grades from 6 to 12. Under the 8 and 4 system this applies to the last two years of Grammar School and to the four of High School. Under the Junior High System it applies to the Junior and Senior High Schools. Instead of teaching only arithmetic in the seventh and eighth grades, algebra, intuitive geometry and numerical trigonometry are introduced. It is in the seventh, eighth, and ninth grades that we find the weak spot of the present system. If the pupils who come from these grades knew arithmetic, some algebra, intuitive geometry, and numerical trigonometry, the task of the High School would be easy, but as a matter of fact they do not know them. Many are not proficient in arithmetic, at least when fractions must be handled. These boys come to the High School with a poorer preparation than the boys of ten years ago, and the High School course has been cut down from four years to three and one-half. This is a defect, which ought to be remedied. In cutting down our mathematical course have we not cut it down too much? Would it be better to add a half year more of algebra? I believe that it would be a help to the teaching of physics and chemistry, if a course in higher algebra should be given in college. An inadequate foundation in mathematics makes boys detest physics, and adds to the troubles of teachers of science.

The Prominence Spectroscope

GEORGE P. McGOWAN, S.J.

In a brief paper, the nature, the adjustment and the purpose of the prominence spectroscope, as used in the Georgetown Astronomical Observatory, was detailed. The unique combination of three triple prisms and two movable mirrors was described. The passage of the ray was traced, and the method of obtaining the hydrogen line, indicating the prominences of the sun, was discussed.

MEMBERSHIP OF ASSOCIATION

1929-1930

GENERAL OFFICERS

President

Rev. Richard B. Schmitt, Loyola College, Baltimore, Md.

Secretary-Treasurer

Joseph T. O'Callahan, Boston College, Newton, Mass.

Executive Council

Very Rev. Edward C. Phillips, 501 Fordham Rd., New York.
Rev. Richard B. Schmitt, Loyola College, Baltimore, Md.
Rev. John A. Frisch, Georgetown University, Washington, D. C.
Rev. George F. Strohaver, Holy Cross College, Worcester, Mass.
Rev. Fred W. Sohon, Georgetown University, Washington, D. C.
Rev. Thomas J. Love, Loyola College, Baltimore, Md.
Joseph T. O'Callahan, Boston College, Newton, Mass.

Editors of Bulletin

Rev. Joseph P. Merrick, Holy Cross College, Worcester, Mass.
Secretaries of Various Sections, Sub-Editors.

Editor of Proceedings

Joseph T. O'Callahan, Boston College, Newton, Mass.

MEMBERS AND SECTION OFFICERS
1929-1930

Note: The figures at the end of each entry indicate the year in which member was admitted to the Association.

HONORARY MEMBER

Mr. George C. Jenkins, 1924, Baltimore, Md.

BIOLOGY SECTION

Chairman, Rev. John A. Frisch, Georgetown University.
Secretary and Sub-Editor of Bulletin, James L. Harley, St. Joseph's College, Philadelphia, Pa.

Members

Avery, Rev. Henry C., 1923. Ateneo de Manila, Manila, P. I.
Berger, Charles A., 1926. Woodstock College, Woodstock, Md.
Busam, Rev. Joseph S., 1922. Holy Cross College, Worcester, Mass.
Coniff, Arthur A., 1928. Gonzaga High School, Washington, D. C.
Didusch, Rev. Joseph S., 1922. Woodstock College, Woodstock, Md.
Dore, Rev. Francis J., 1922. Boston College, Boston, Mass.
Dubois, Evan C., 1924. Weston College, Weston, Mass.
Freatman, Harold L., 1924. Woodstock College, Woodstock, Md.
Frisch, Rev. John A., 1924. Georgetown University, Washington, D. C.
Harley, James L., 1927. St. Joseph's College, Philadelphia, Pa.
Hugal, Francis A., 1926. Weston College, Weston, Mass.

Kischgessner, George J., 1925. Woodstock College, Woodstock, Md.
MacCormack, A. J., 1925. Weston College, Weston, Mass.
McCauley, Rev. David V., 1923. Canisius College, Buffalo, N. Y.
Pollock, Rev. John A., 1923. Mindanao, P. I.
Reardon, Rev. Francis X., 1925. Woodstock College, Woodstock, Md.
Shaffrey, Rev. Clarence E., 1923. St. Joseph's College, Philadelphia, Pa.
Tondorf, Rev. Francis A., 1923. Georgetown University, Washington, D. C.

CHEMISTRY SECTION

Officers (1929-1930)

Chairman, Rev. Geo. F. Strohaver, Holy Cross College, Worcester, Mass.
Secretary and Sub-Editor of the Bulletin, Edward S. Hauber, Holy Cross College, Worcester, Mass.

Members

Ahern, Rev. M. J., 1922. Weston College, Weston, Mass.
Bihler, Rev. H. J., 1925. Woodstock College, Woodstock, Md.
Blatchford, Rev. J. A., 1923. Weston College, Weston, Mass.
Brosnan, Rev. J. A., 1923. Wernersville, Pa.
Brown, Rev. J. T., 1922. St. Joseph's College, Philadelphia, Pa.
Butler, Rev. T. J., 1922. St. Andrew-on-Hudson, Poughkeepsie, N. Y.
Carroll, A. G., 1929. Holy Cross College, Worcester, Mass.
Coyle, Rev. G. L., 1922. Georgetown University, Washington, D. C.
Gisel, E. A., 1925. Woodstock College, Woodstock, Md.
Gookin, Rev. V. A., 1923. Weston College, Weston, Mass.
Gorman, L. G., 1926. Woodstock College, Woodstock, Md.
Hauber, E. S., 1929. Holy Cross College, Worcester, Mass.
Hohman, Rev. A. J., 1922. Woodstock College, Woodstock, Md.
Langguth, Rev. A. B., 1924. Holy Cross College, Worcester, Mass.
MacLeod, H. C., 1924. Weston College, Weston, Mass.
Martin, Rev. R., 1923. Fordham University, New York City.
McCullough, Rev. H. B., 1923. Ateneo de Manila, Manila, P. I.
Molloy, J. J., 1929. Holy Cross College, Worcester, Mass.
Muenzen, Rev. J. B., 1923. Fordham University, New York City.
Power, Rev. F. W., 1924. Weston College, Weston, Mass.
Schmitt, Rev. R. B., 1923. Loyola College, Baltimore, Md.
Sohon, Rev. F. W., 1923. Georgetown University, Washington, D. C.
Strohaver, Rev. G. F., 1922. Holy Cross College, Worcester, Mass.
Sullivan, Rev. J. J., 1923. Boston College, Newton, Mass.
Tivnan, Rev. E. P., 1923. Weston College, Weston, Mass.
Whelan, Rev. J. F., 1926. Woodstock College, Woodstock, Md.
Wolff, E. J., 1926. Weston College, Weston, Mass.

MATHEMATICS SECTION

Officers (1929-1930)

Chairman, Rev. F. W. Sohon, Georgetown University, Washington, D. C.
Secretary and Sub-Editor of the Bulletin, G. P. McGowan, Georgetown University.

Members

Archer, Rev. Peter, 1922. Canisius College, Buffalo, N. Y.
Barry, Thomas D., 1926. Weston College, Weston, Mass.
Berry, Rev. E. B., 1922. St. Francis Xavier School, New York City.
Bouwhuis, Rev. A. L., 1923. Fordham University, New York City.
Brock, Rev. H. M., 1922. Weston College, Weston, Mass.
Carasig, Rev. P. M., 1923. San Jose Observatory, Manila, P. I.
Codaire, G. A., 1924. Weston College, Weston, Mass.
Crawford, Rev. W. R., 1924. Holy Cross College, Worcester, Mass.
Cusick, W. H., 1928. Boston High School, Boston, Mass.
Dawson, Rev. J. F., 1923. Woodstock College, Woodstock, Md.
Depperman, Rev. C. E., 1923. San Jose Observatory, Manila, P. I.
d'Invilliers, J. A., 1927. St. Francis Xavier School, New York City.
Doucette, B. F., 1925. Weston College, Weston, Mass.
Fey, L. F., 1926. Canisius High School, Buffalo, New York.
Gipprich, Rev. J. L., 1922. Georgetown University, Washington, D. C.
Kelly, Rev. J. P., 1922. Tertianship.
Kelly, Rev. J., 1922. Loyola High School, Baltimore, Md.
Kennedy, W. W., 1923. Weston College, Weston, Mass.
Logue, Rev. L. R., 1923. Weston College, Weston, Mass.
Long, J. J., 1924. Woodstock College, Woodstock, Md.
McCormack, Rev. J. T., 1923. Boston High School, Boston, Mass.
McGarry, Rev. W. J., 1923. Biblical Institute, Rome.
McLaughlin, Rev. T. L., 1923. Weston College, Weston, Mass.
McNally, Rev. P. A., 1923. Georgetown University, Washington, D. C.
Murray, J. L., 1925. Holy Cross College, Worcester, Mass.
Nuttall, E. J., 1925. Woodstock College, Woodstock, Md.
O'Callahan, J. T., 1929. Boston College, Newton, Mass.
O'Donnell, Rev. G. A., 1924. Weston College, Weston, Mass.
O'Loughlin, Rev. F. D., 1923. Fordham University, New York.
O'Mahoney, T. J., 1926. Weston College, Weston, Mass.
Phillips, Very Rev. Edward C., 1922. 501 E. Fordham Rd., New York.
Quigley, T. H., 1925. Weston College, Weston, Mass.
Repetti, Rev. W. C., San Jose Observatory, Manila, P. I.
Roth, Rev. A. C., 1923. Woodstock College, Woodstock, Md.
Roth, Rev. C. A., 1923. Woodstock College, Woodstock, Md.
Setter, Rev. J. G., 1928. Canisius High, Buffalo, N. Y.
Smith, Rev. J. P., 1923. St. Peter's College, Jersey City, N. J.
Sheehan, W. D., 1928. Holy Cross College, Worcester, Mass.
Wessling, Rev. H. J., 1923. Boston High School, Boston, Mass.

PHYSICS SECTION

Officers (1928-1929)

Chairman, Rev. T. J. Love, Loyola College, Baltimore, Md.
Secretary and Sub-Editor of the Bulletin, W. D. Sheehan, Holy Cross College.

Members

Bahlman, G. H., 1929. Brooklyn High School, New York.

Berry, Rev. E. B., 1922. St. Francis Xavier School, New York.
Brock, Rev. H. M., 1922. Weston College, Weston, Mass.
Codaire, G. A., 1924. Weston College, Weston, Mass.
Crawford, Rev. W. R., 1924. Holy Cross College, Worcester, Mass.
Dawson, Rev. J. F., 1923. Woodstock College, Woodstock, Md.
Delaney, Rev. J. P., 1923. Caniscius High School, Buffalo, N. Y.
Zepperman, Rev. C. E., 1923. San Jose Observatory, Manila, P. I.
d'Jinvilliers, J. A., 1927. St. Francis Xavier High School, New York City.
Doucette, B. F., 1925. Weston College, Weston, Mass.
Fay, Rev. T. A., 1923. Holy Cross College, Worcester, Mass.
Fey, L. F., 1926. Canisius High School, Buffalo, N. Y.
Gipprich, Rev. J. L., 1922. Georgetown University, Washington, D. C.
Hearn, J. R., 1925. Woodstock College, Woodstock, Md.
Kollmeyer, Rev. E. J., 1922. Georgetown University, Washington, D. C.
Loeffler, J. D., 1929. Boston High School, Boston, Mass.
Logue, Rev. W. G., 1923. Woodstock College, Woodstock, Md.
Long, J. J., 1924. Woodstock College, Woodstock, Md.
Love, Rev. T. J., 1923. Loyola College, Baltimore, Md.
Lynch, Rev. D. J., 1923. Boston College, Newton, Mass.
Lynch, Rev. J. J., Fordham University, New York.
Mahoney, Rev. D. P., 1924. Weston College, Weston, Mass.
Mahoney, Rev. J. B., 1925. Ateneo de Manila, P. I.
McGowan, George P., 1928. Georgetown University, Washington, D. C.
McLaughlin, Rev. T. L., 1923. Weston College, Weston, Mass.
McNally, Rev. H. P., 1922. Georgetown Preparatory, Garrett Park, Md.
Merrick, Rev. J. P., 1923. Holy Cross College, Worcester, Mass.
Miley, Rev. T. H., 1923. St. Joseph's College, Philadelphia, Pa.
Moore, T. H., 1923. Woodstock College, Woodstock, Md.
Murray, J. L., 1928. Holy Cross College, Worcester, Mass.
Nuttall, E. J., 1928. Woodstock College, Woodstock, Md.
O'Callahan, J. T., 1929. Boston College, Boston, Mass.
O'Connor, J. S., 1928. St. Louis University, St. Louis, Mo.
O'Loughlin, Rev. F. D., 1923. Fordham University, New York.
Phillips, Very Rev. Edward C., 501 Fordham Rd., New York.
Quigley, T. H., 1925. Weston College, Weston, Mass.
Rafferty, Rev. P., 1923. Cagayan, Mindanao, P. I.
Roth, Rev. A. C., 1923. Woodstock College, Woodstock, Md.
Sheehan, W. D., 1928. Holy Cross College, Worcester, Mass.
Smith, T. J., 1926. Weston College, Weston, Mass.
Sullivan, Rev. D. H., 1923. Cagayan, Mindanao, P. I.
Tobin, Rev. J. A., 1923. Boston College, Newton, Mass.
Tynan, J. W., 1926. Woodstock College, Woodstock, Md.